4. Once all divers are clear of the water and boats have been moved to a safe location, fire the explosive cutter. The detonation resulting from the detonation may be heard and or felt on the surface. **Note – do not allow any personnel or equipment to be in direct line with the detonation (96" columns)! All personnel and equipment will be to the side at a safe distance to be determined by the Explosive Technician on site.**
5. Once the detonation has taken place and it is safe to do, repeat operation until all columns are safely severed.

**Step 5. Detonating the explosive charges.**

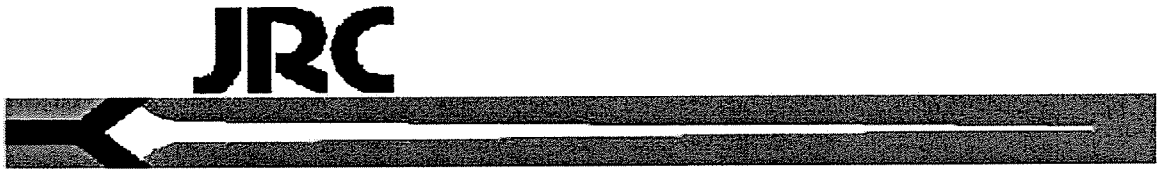
Once again check the surrounding area, making sure all personnel, boat traffic and other equipment are clear and out of danger and at a safe distance. Connect firing line to the appropriate firing device. Sound the required signals to alert personnel that a detonation is about to take place. During this time make sure no personnel stray into the danger area, at the appropriate time and when it is ascertained the area is clear; detonate the charges.

**Step 6. Sounding the all clear.**

Once the charges have detonated, and the column has dropped the offshore project manager and blaster will check the area and pass the word that it is safe to resume normal operations. Once this is done, the required "ALL CLEAR" signals will be sounded and normal operations can resume. Repeat as required to finish the job.



E-11




# III. SAFETY PROCEDURES AND MISFIRE CONTINGENCIES

## JET RESEARCH CENTER

## SPECIALTY (EXPLOSIVE) SERVICES



EIV

## INTRODUCTION

The handling of explosives and explosive articles is an integral part of the daily operations conducted by the Specialty (Explosive) Services Department on the job site. Safety during all operations associated with explosive has always been and continues to be a prime concern and, therefore, has high priority in the establishment of the direction that all projects will follow. This document has been prepared to provide a fundamental set of safety standards for all explosives handling operations.

## PURPOSE

This document prescribes the minimum safety practices to be employed during operations involving explosives, conducted by the Specialty (Explosive) Services.

## SCOPE

The procedures outlined in this document and all appendices are applicable to all JET RESEARCH CENTER personnel, and visitors, engaged in operations of development, manufacturing, handling, storage, on-site transportation, processing, or testing of energetic materials, explosives and/or explosive articles on the Engineering Test Range, in the Research and Engineering Building and all work location at all job sites.

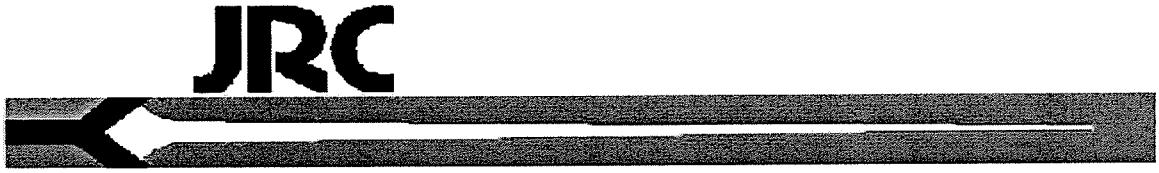
This document contains the general guidelines and standards for the above types of operations, and is to be implemented to safeguard personnel and to prevent property damage. The appendices provide standard operating procedures for specific testing apparatus/operations/locations within areas under the control of the Specialty (Explosive) Services.

Criteria established in this document are not only peculiar to high explosive operations, but shall also apply to operations involving propellants, pyrotechnics, and fuel/air mixtures when those materials may undergo explosive reactions.

The standards developed in this document deal with any operations involving explosives and the safe management of those operations. These standards are in addition to any other safety policies/regulations promulgated by the company or a government regulatory agency.



E 13




## DEFINITIONS

For the purposes of clarity throughout this document, the following terms are defined:

**Approved** - Complying with the provisions of this document and with instructions issued by management personnel having jurisdiction over the Specialty Explosive) Services.

**Barricade** - An intervening approved barrier, natural or artificial, of such type, size, and construction so as to limit in a prescribed manner, the effect of an explosion on nearby building or personnel exposures.

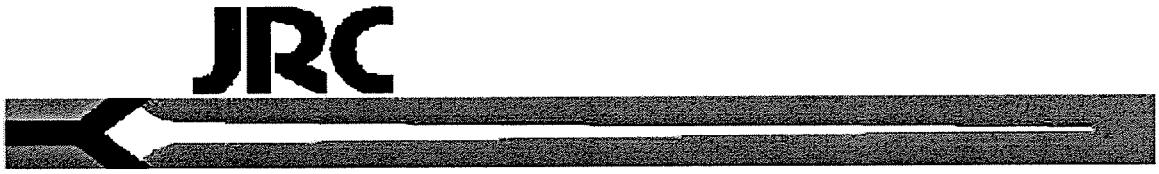
**Blending** - The mixing of solid materials (usually dry) by gravity flow, usually induced by vessel rotation.

**Booster** - Booster or boosting explosives are explosives used in an explosive train to amplify the shock output of the initiating device and cause detonation of the main explosive charge.

**Casual** - A person who may be temporarily present in the vicinity of explosive operations, but whose presence is not necessary for that operation to be conducted.

**Combustible Material** - Any material which, when ignited, will sustain combustion.

**Compatibility** - The property of two or more materials to coexist in intimate contact without adverse reaction for an acceptable period of time. Materials may be stored together when they do not increase the probability of an accident or for a given quantity, the magnitude of the effects of such an accident. Storage compatibility groups are thus assigned to provide for mixed storage.




# JET RESEARCH CENTER

**Control Point** - The location used for personnel control and operation coordination in high explosives operating or tests area.

**Critical Temperature** - Temperature above which self-heating of an explosive causes a violent runaway reaction. It is dependent on mass, geometry and thermal boundary conditions.

**Deflagration** - A rapid chemical reaction in which the output of heat is sufficient to enable the reaction to proceed and be accelerated without input of heat from another source. Deflagration is a surface phenomenon with the reaction products flowing away from the unreacted material along the surface at subsonic velocity. The effect of a true deflagration under confinement is an explosion. Confinement of the reaction increases pressure, rate of reaction and temperature, and may cause transition into a detonation.

**Detonation** - A violent chemical reaction within a chemical compound or mechanical mixture evolving heat and pressure. A detonation is a reaction, which proceeds through the reacted material toward the unreacted material at a supersonic velocity. The result of the chemical reaction is exertion of extremely high pressure on the surrounding medium forming a propagating shock wave, which is originally of supersonic velocity. A detonation, when the material is located on or near the surface of the ground, is normally characterized by a crater.

**Detonator** - Any device containing any initiating or primary explosive that is used for initiating detonation. The term includes, but not limited to, electric blasting caps (instantaneous or delay), blasting caps for use with safety fuses, detonating cord delay connectors, and nonelectric blasting caps (instantaneous or delay) which use detonating cord, shock tube, or any other replacement for electric leg wires. The electric blasting caps can be further subdivided as hot wire detonators, resistorized detonators, or RF-protected Rig Environment (RED) Detonators.

**Exploding Bridgewire (EBW)** - An Electro-Explosive Device (EED) which is initiated by the discharge of a high current through the device bridgewire, causing the wire to explode and produce a shock wave. An EBW as defined herein is a device containing no primary explosive.

**Explosive** - Any chemical compound or mechanical mixture which, when subjected to heat, impact, friction, shock, or other suitable initiation stimulus, undergoes a very rapid chemical change with the evolution of large volumes of high temperature gases which exert pressures in the surrounding medium. The term applies to materials that either detonate or deflagrate.

**Explosive Decontamination** - The removal of hazardous explosive material.

**Firing Site** - Controlled access area where firing of explosives is conducted.

**Flammable Liquid** - Any liquid having a flash point below 60 C and a vapor pressure not exceeding 280 kPa (41 psia) at 37.8 C. This is the definition as applied in this manual and includes some materials defined as combustible liquids by the Department of Transportation (DOT).

**Flash Point** - The temperature at which a liquid or volatile solid gives off a vapor sufficient to form an ignitable mixture with air near the surface of the material or within the test vessel.

**Hot Work (Thermal)** - Any operation requiring the use of a flame producing device, an electrically heated tool producing a temperature higher than 228°F, or a mechanical tool which could produce sparks or could heat explosives or explosives contamination to provide an initiation stimulus.

**In-Process Storage Magazine** - See "Service Magazine".

**Inhabited Building** - A building or structure other than operating buildings, magazines and auxiliary buildings occupied in whole or in part as a habitation for people or where people are accustomed to assemble, both within and outside of the company facility.

**Initiation Stimulus** - Energy input to an explosive in a form potentially capable of initiating a rapid decomposition reaction. Typical initiation stimuli are heat, friction, impact, electrical discharge, and shock.

**Intraline Distance** - The distance to be maintained between any two operating buildings and sites within an operating line, at least one of which contains, or is designed to contain explosives.

**Lower Explosive Limit (LEL)** - The concentration of vapor or dust in air below which an explosion cannot occur.

**Lower Flammable Limit (LFL)** - The concentration of a vapor or dust in air below which a burning reaction cannot be sustained.

**Magazine** - Any building, structure or container, other than an explosives manufacturing building, approved for the storage of explosives materials.

**Melting** - Operations involving change in the state of explosive material from solid to liquid.

**Milling** - Operations which either reduce solid material particle size by attrition or which apply high shear mixing to incorporate solid materials to plastic materials. Also may refer to a surface machining operation.

**Mixing** - An operation which combines dissimilar materials by mechanical means.

**Operational Shield** - A barrier constructed to protect personnel, material, or equipment from the effects of a possible fire or explosion occurring at a particular operation.

**Personnel Barrier** - A device designed to limit or prevent personnel access to a building or an area during a hazardous operation.

**Pressing** - An operation resulting in the increase in density of the explosive material affected by the application of pressure.

**Primer** - A unit, package, or cartridge of explosives used to initiate other explosives and which contains:

1. A detonator, or
2. Detonating cord to which is attached a detonator designed to initiate the detonating cord.

**Propellant** - Explosive composition used to propel projectiles and rockets and to generate gases for powering auxiliary devices.

**Pyrotechnic Material** - Physical mixtures of finely divided fuels and oxidizer powders and may include various organic binders and color intensifiers. Once ignited, the mixture rapidly evolves a considerable amount of heat and gas.

**Risk** - A measure of the combination of the probability and the consequences of the hazards of an operation expressed in qualitative or quantitative terms.

**Safety Analysis** - A document prepared to systematically identify the hazards of an operation, to describe and analyze the adequacy of the measures taken to eliminate, control, or mitigate identified hazards, and to analyze and evaluate potential accidents and their associated risks.

**Safety Fuse** - A flexible cord containing an internal burning medium by which fire or flame is conveyed at a continuous and uniform rate from the point of ignition to the point of use, usually a fuse detonator.

**Screening** - An operation utilizing screens to separate particles of differing sizes.

**Service Magazine** - An auxiliary building or suitably designated room (vault) used for the intermediate storage of explosives materials not exceeding the minimum amount necessary for safe, efficient operation.

**Shunt** - Electrically interconnecting various portions of EED circuitry so as to prevent the development of an electrical charge differential between the shunted parts



E/7

**Storage Magazine** - A structure designed or specifically designated for the long-term storage of explosives or ammunition.

**TNT Equivalent** - A measure of the blast effects from explosion of a given quantity of material expressed in terms of the weight of TNT, which would produce the same blast effects when, detonated.

## SAFE PRACTICES

General:

This section provides general safe practices for all explosive operations addressed in this document. When these practices exceed or differ from local, state or national codes, regulations or requirements, the more restrictive shall apply.

Personnel and Materials Limits:

The overriding concern to be observed in any operation or at any location where working with explosives, or explosive assemblies, are involved is to limit exposure to a minimum number of personnel, for a minimum amount of time, to the minimum amount of explosive materials consistent with safe and efficient operations.

Standard Operating Procedures (SOPs):

a) Any operation involving explosive materials, being conducted on the job site, will require a Job site HSE meeting report & Emergency response plan. These Job site HSE meeting report & Emergency response plan shall be developed by the Services Supervisor, reviewed & approved by the Service Coordinator or Team Coordinator.

b) The, Job site HSE meeting report & Emergency response plan shall be developed and approved for a specific location or operation, shall be posted in a spot convenient to all personnel involved in the operation.

c) All Job site HSE meeting report & Emergency response plan shall be reviewed, revised, and reapproved, as necessary, whenever there is any change in methods, any equipment substitutions/modifications, or process revisions.

## GENERAL WARNINGS AND PROCEDURES

Prevention of Accidents:



E12

Prevention of accidents depends on careful planning and the use of proper procedures.

Misuse of any explosive material can kill or injure you or others.

This document is intended to help you use explosive materials safely.

General Warnings:

All explosive materials are dangerous and must be carefully transported, handled, stored and used following proper safety procedures.

**ALWAYS** follow federal, state, and local laws and regulations.

**ALWAYS** lock up explosive materials and keep from children and unauthorized persons.

## STORING EXPLOSIVE MATERIALS

Location/Construction of Magazines:

**ALWAYS** separate magazines from other magazines, inhabited buildings, highways, and passenger railroads in accordance with the "American Table of Distances".

**NEVER** allow combustible material to accumulate within 25 feet of the magazine.

**NEVER** allow any lighters, matches, open flame, or other sources of ignition or volatile materials within 50 feet of the magazine.

**NEVER** attempt to make repairs to the inside or outside of a magazine containing explosive materials.

**ALWAYS** ensure magazines are solidly built and securely locked to protect against weather, fire, and theft.

**ALWAYS** keep the inside of the magazine clean, dry, cool, and well ventilated.

**ALWAYS** post the area around the magazine with clearly visible "EXPLOSIVES - KEEP OUT" signs.

Contents of Magazines:

**ALWAYS** clean up spills immediately.

**ALWAYS** rotate stocks of explosive materials so the oldest material in the magazine is used first.

**NEVER** store detonators with other explosive materials.

**NEVER** use explosive materials, which seem deteriorated.

**NEVER** perform any type of operation in a magazine other than inspection, inventory, or bringing in/taking out explosive materials.

## TRANSPORTING EXPLOSIVE MATERIALS

**ALWAYS** keep matches, lighters, open flame, and other sources of ignition at least 50 feet away from parked vehicles carrying explosive materials.

**ALWAYS** load and unload explosive materials carefully.

**NEVER** park vehicles containing explosive materials close to people or congested areas.

**NEVER** leave a vehicle containing explosive material unattended.

## HANDLING EXPLOSIVE MATERIALS

General:

**ALWAYS** keep explosive materials away from children and unauthorized persons.

**NEVER** handle explosive materials unless completely familiar with safety procedures.

**NEVER** handle explosive materials during, or during the approach of, an electrical storm.

**NEVER** fight fires involving explosive materials. Remove yourself and all others to a safe location and guard the area.

**NEVER** put explosive materials in pockets of your clothing.

Packaging:

**ALWAYS** close partially used packages of explosive materials.

**ALWAYS** store explosives in their original package.